PATENT SPECIFICATION

NO DRAWINGS

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International Classification:—B29d, f.

COMPLETE SPECIFICATION

Moulding Foamed Polymeric Articles

We, MONSANTO CHEMICALS LIMITED, a British Company, of Monsanto House, 10—18, Victoria Street, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for moulding foamed polymeric articles, and particularly to a vacuum forming process for foamed polymeric sheet.

In recent years there has been considerable development in the use of foamed polymeric materials, which have a low bulk density and a high degree of thermal insulation; this combination of properties has resulted in them being used as lightweight insulating and packaging media.

However, sheets of foamed polymeric materials have sometimes proved difficult to mould by the well-known method of vacuum forming. This is because, owing to their high degree of thermal insulation, only thin sheets can be sufficiently heat softened, whilst such thin sheets of foamed polymeric materials are too porous to be used in the vacuum forming process.

It has now been found that a thin sheet of foamed thermoplastic material can readily be moulded by a vacuum forming process by placing a thermoplastic resin film on the side of the foamed material furthest from the mould and vacuum forming the film and the sheet together; the film and the sheet become bonded together to form a laminate.

The process of the invention is therefore one for moulding a thin sheet of foamed thermoplastic material by vacuum forming, in which a thermoplastic resin film is placed on the side of the sheet of foamed thermoplastic material furthest from the mould and the film and sheet are vacuum formed together.

The foamed thermoplastic material can comprise any polymer which can be suitably expanded, particularly a polyvinyl polymer such as for instance polystyrene, polyethylene or polyvinyl chloride. A polymer such as these can be foamed by means of a foaming agent incorporated in the polymer, for example an agent that is a volatile liquid or a chemical capable of decomposition to gaseous products. A particularly useful foamed thermoplastic material is foamed polystyrene.

The film can be of any thermoplastic resin which can be vacuum formed and which bonds to the foamed material under the appropriate conditions. Examples of suitable resins are polyethylene, polyvinyl chloride, acrylic resins (including polymethyl methacrylate), and various polymers of polystyrene such as a styrene homopolymer or a copolymer of styrene with another monomer such as butadiene or acrylonitrile. A toughened polystyrene, that is a polystyrene which has been modified by means of a natural or synthetic rubber, can be used if desired. The resin of the film can be chemically the same as or different from the foamed material, but the two components should not have softening points which differ greatly from each other, otherwise complete heat softening before vacuum forming will be difficult to achieve.

Examples of combinations which can be used are a foamed polystyrene sheet with a polystyrene or toughened polystyrene film; and a foamed polystyrene sheet with polyethylene film.

Both the film and the foamed sheet should be thick enough to withstand being drawn down into the mould-box without rupture, but should not be so thick that they cannot be softened before vacuum is applied. The thickness of the foamed sheet depends on its softening point and on its thermal conductivity, but in general it can be from about 0.005 to about 0.25 inch thick; a very suitable thickness is between 0.05 or 0.07 and 0.15

inch, for instance 0.1 inch. The thickness of the film depends on its softening point and on that of the foamed material; if the softening point of the film is higher than that of the foamed material then the film should be thin, for instance between 0.001 inch and 0.02 inch thick, but if the softening point of the film is lower than that of the foamed material the film can be thicker, for instance from 0.02 inch to 0.05 inch thick. Where polyethylene film is used in conjunction with foamed polystyrene sheet a very suitable film thickness is about 0.002 inch.

The thin sheet of foamed thermoplastic material, particularly if this is foamed polystyrene, can be one made by cutting a block of the material into slices, but a sheet made by an extrusion process can also be used, and gives excellent results.

An interlayer which does not prevent the thermoplastic film from being drawn on to the foamed sheet can if desired be inserted between the film and the sheet before they are moulded, and the properties of the laminate can sometimes be improved by this means. The interlayer can, for instance, be used to provide strength or decorative effects; it need not be thermoplastic. The interlayer need not be continuous, but it should of course be sufficiently porous to permit the air to be withdrawn evenly from between it and the thermoplastic film. Suitable interlayers can be provided by paper, fabric, metal foils, filaments of metals or of polymers, glass fibre mats, or woven glass cloth.

In carrying out the vacuum forming operation the conventional mould box and moulds can be used, the sheet of foamed thermoplastic material being placed nearer to the mould than the film of thermoplastic resin. As in the normal vacuum forming process the foamed sheet and the film are clamped around the edges of the mould box in such a way as to prevent air from entering into the interior of the box during the moulding operation. The heater is then applied to the film, and when the layers have reached the correct temperature air is withdrawn from the mould box to complete the moulding.

By means of this invention a wide variety of useful plastic articles can be provided, such as for instance light-weight packages for the transport of fragile articles, and for this purpose the laminates can be produced in the form of a box or of a moulded container which closely surrounds the articles to be packed.

The invention is illustrated by the following Example:—

EXAMPLE

This Example describes the way in which a thin sheet of foamed polystyrene was vacuum formed in conjunction with a polyethylene film.

A sheet of foamed polystyrene (density 4 pounds per cubic foot), 8 inches by 8 inches by 0.1 inch thick, was placed over the mould box of a vacuum forming apparatus, and a polyethylene film 8 inches by 8 inches by 0.002 inch thick was placed on top. The mould was one yielding a shallow tray. The edges of the sheet and the film were clamped over the mould box, and an infra-red heater was held in position over the film until its surface temperature as measured by a thermocouple was 120° C. (this required about 1 minute). The heater was then removed and vacuum was applied to the box to mould the sheet and film. When the moulded article had cooled it was removed and trimmed to size.

It was found that the polyethylene film had become bonded to the foamed polystyrene sheet; the resulting laminate in the form of a shallow tray was substantially impervious to air and water vapour.

WHAT WE CLAIM IS:—

1. A process for moulding a thin sheet of foamed thermoplastic material by vacuum forming, in which a thermoplastic resin film is placed on the side of the sheet of foamed thermoplastic material furthest from the mould and the film and sheet are vacuum formed together.

2. A process according to Claim 1, in which the foamed thermoplastic material is foamed polystyrene.

3. A process according to either Claim 1 or Claim 2, in which the thermoplastic resin film is polystyrene or polyethylene.

4. A process according to any of Claims 1 to 3, in which the thickness of the sheet of foamed thermoplastic material is between 0.005 inch and 0.25 inch.

5. A process according to Claim 4, in which the thickness of the sheet of foamed thermoplastic material is between 0.05 inch and 0.15 inch.

6. A process according to any of Claims 1 to 5, in which the thickness of the thermoplastic resin film is between 0.001 inch and 0.05 inch.

7. A process according to any of Claims 1 to 6, in which a porous interlayer is inserted between the film and the sheet before they are moulded.

8. A process for moulding a thin sheet of foamed thermoplastic material by vacuum forming, substantially as described in the Example.

9. A vacuum formed sheet of foamed thermoplastic material that has been made by a process according to any of Claims 1 to 8.

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PROVISIONAL SPECIFICATION

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